

Public Release Report for DOE-Sponsored Energy Savings Assessment Conducted at Terra Nitrogen Verdigris Plant:

Introduction:

Ammonia- and urea-based fertilizers are produced from hydrogen and carbon obtained from natural gas. Unlike in other industries, the purchased natural gas is also used as feedstock (60% of the total) in this plant. The process involves raising the feedstock to elevated temperatures and pressures, and storing intermediate products in refrigerated tanks.

Nearly \$1M in natural gas is required for each day to operate this energy-intensive process plant. Even a small fraction of energy saving will significantly reduce the natural gas use at this site.

Objective of ESA:

To provide U.S. industries technical assistance targeted to reduce fuel expenditure.

Focus of Assessment:

The focus of the steam Energy Savings Assessment (ESA) is as follows: (1) to identify energy waste reduction opportunities and (2) to train in-plant personnel to continue and sustain the improvement. This plant generates over 1.5 million lbs/hr of steam from its auxiliary boilers, waste heat boilers, and utility boilers. Hence, the ESA is focused in the largest steam generating process plant of the region.

Approach for ESA:

USDOE qualified specialist provided training to the plant engineer in the USDOE Steam Tools Suite and facilitated the completion of an abbreviated ESA of the facility.

General Observations of Potential Opportunities:

Everyday, over 110,000 MMBtu of natural gas is consumed at this site. The reported natural gas use in Terra Nitrogen's Verdigris plant is 39 million MMBtu/yr. Approximately 13 million MMBtu/yr of natural gas is consumed as fuel to meet the energy needs of this continuous process plant. While many factors influence natural gas costs making it difficult to predict the future price of natural gas \$8.00/MMBtu has been used to evaluate the financial impact of possible energy savings at this plant.

The plant's average electrical demand is about 18,500 kW; all electricity is purchased from the utility grids. The impact electricity cost is \$0.071/kWh.

With the help of plant's engineering team, DOE's preliminary assessment in January 2006 has identified the following potential opportunities to reduce natural gas usage: They are classified as near, medium, and long term opportunities.

Near term:	Any housekeeping improvements and minor changes in the operating practices,
Medium term:	Simple modifications that should not change the initial process design,
Long term:	Modifications that require changes in the process design and require large equipment.

1. (Medium term) - Reduce HP steam demand by synthesis loop modification (~20 klbs/hr HP Reduction) Synthesis loop modification would improve the overall plant efficiency by about 0.4% and hence the HP steam demand is expected to come down by about 20.0 klbs/hr
2. (Medium term) - Reduce LP steam demand and venting by modifying 107JT Turbine (~15 klbs/hr LP Reduction) by changing the above backpressure turbine with a condensing turbine, LP steam generation, and subsequently, its venting will be reduced.
3. (Medium term) - Implement a steam trap maintenance program by adopting better trap installation techniques. Maintaining the steam traps is a routine housekeeping activity. It should be continued to maintain a near zero failure rate.
4. (Near term) - Implement a steam leak maintenance program to fix all the visible steam leaks at the site. Steam leak elimination is a routine housekeeping activity and should be continued to maintain a near zero leak rate.

The plant engineers were already working on the above four potential opportunities.

5. (Long term) Reduce HP steam demand by procuring high-pressure natural gas to eliminate operating the gas compressors. Currently, the purchased natural gas is compressed at the site to meet the process requirement. Generally, the gas companies transport large quantities of natural gas in pipelines at higher pressure to minimize line friction. Since Oklahoma is a major gas producing state, it is possible there could be some HP gas pipeline

running within about 4 - 5 miles from Terra Nitrogen's Verdigris plant. If that gas company is willing to sell HP gas directly to Terra Nitrogen, it is worthwhile to develop this opportunity further. However it should be noted that enough (FEED) Front End Engineering Design needs to be done, since a new dedicated pipeline would require proper sizing, pipeline branching, and metering system installations. Also, such a pipeline could cost about \$1M per mile of installation. Some other process changes like additional heating of the gas to process conditions should be taken into account, though there is a possibility of integrating with low level heat recovery for this heating need.

6. (Near term) Reduce LP steam demand by recovering more flash steam from blowdown (B/D) water. At present, a considerable quantity of B/D water, after flashing to the LP steam header, is sent to the cooling tower at 50-psig and 300°F. If the B/D water is routed to the deaerator directly, an additional amount of 1200 lbs/hr of flash steam can be generated.
7. (Long term) Change boiler efficiency by reducing the stack temperatures of Aux Boiler #1 from 400°F to 320°F. The Aux. boiler in Ammonia plant #2 has an air preheater that facilitates the recovery of heat from its stack. If a similar or modified heat recovery arrangement is implemented in the Aux. Boiler in Ammonia plant #1, a 2% fuel savings can be achieved at Aux Boiler #1.
8. (Medium term) Modify the operation of condensing turbines by increasing vacuum at their surface condensers. At present the vacuum in the surface condensers of the condensing turbine are maintained between 24-in. to 26-in. of Hg depending on the summer and winter conditions. Low-level waste heat recovery at the Terra Nitrogen site could power a suitably sized absorption chiller. This absorption chiller could cool the supply side cooling tower water and could improve the vacuum by additional 0.5-in. of Hg.

The USDOE Steam System Assessment Tool Excel spreadsheet was modified to best fit the integrated nitrogen complex system. Based on this modified model, there is a potential reduction in fuel natural gas use is 10.5%. Of the total 10.5% reduction, the 3-Near-term measures could reduce 0.2%, the 4-Medium-term measures could reduce 9.4% and the single Long-term measure could reduce 0.9% of the natural gas use.

The following six additional energy cost savings opportunities also exist, but could be considered after implementing the above recommended measures:

- Use an alternative fuel (use fuel gas from coal or refinery coke gasification unit instead of natural gas)
- Add operation of backpressure steam turbine (550- to 235-psig at urea strippers)
- Change boiler efficiency by installing duct burners at the HRSG of Acid plant #1.
- Consider inlet air cooling to the gas turbine at Acid plant #1.
- Improve insulation by insulating the bare valves and flanges in hot pipelines and heat exchangers.
- Recover heat from process streams that are above 250°F and cooled using cooling tower water.

Of these six additional opportunities, the alternative coal or coke gasification to substitute natural gas use in Ammonia plants is a paradigm shift in natural gas use and could save trillion BTUs of natural gas for the country every day. It may be worthwhile for **DOE and the federal government to pursue this opportunity as a separately funded initiative** that could release a substantial quantity of natural gas from the ammonia-based fertilizer plants in the U.S.

Management Support and Comments:

Terra Nitrogen Verdigris management encourages any effort that reduces natural gas usage at its plant. The plant manager and his team show enthusiasm toward reducing the natural gas cost at their plant. They expressed their awareness of the high cost of natural gas and its impact on the very survival of their plant operation. An additional concern that could impact the justification of some of these major projects is the quantity and availability of imported nitrogen fertilizer from foreign countries with significantly lower natural gas costs.

DOE Contact at Plant/Company: (whom DOE would contact for follow-up regarding progress in implementing ESA results...)

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